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ABSTRACT

A study was conducted at Burlington County College to investigate the relationship between the academic characteristics and course completion of students enrolled in General College Chemistry (CHE 105) in fall 1985. The study involved an examination of students' academic records and a survey of students who did not successfully pass the course. Of the 126 students who enrolled in the course, 21.4% received an A, 21.4% a B, 26.2% a C, 2.3% a D, 13.5% an F, 4.7% an X (withdrawal after mid-term for non-academic reasons), 6.3% a W (withdrawal before mid-term), 2.3% an E (withdrawal for medical reasons), and 1.6% a Z (withdrawal during the first 10 days of the term). Study findings included the following: (1) students who received an A in CHE 105 had a mean grade point average (GPA) of 3.65 and had completed 85.3% of the credits they had attempted; (2) students who received a D or F grade or withdrew from the class had a GPA of 1.41 and had completed only 38.5% of the credits attempted; (3) there was a slight positive correlation between students previous math experience and success in CHE 105; and (4) students who did not successfully complete the course found the most difficult part of CHE 105 to be the time pressure to complete assignments and prepare for exams. Based on study findings, it was recommended that placement criteria in CHE 105 be a GPA of at least 2.0, a course completion ratio of at least 73%, previous math experience at least at the level of intermediate algebra, and recent successful completion of an introductory chemistry course or equivalent. (EJV)

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May 1988

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A Retention Study at Burlington County College in General College Chemistry

Vincent J. Sollimo

Since a significant drop in enrollment of students in the 18-24 year old range is predicted in the 1990's it behooves colleges and universities to establish more effective retention strategies (1). Nationwide attrition of students in colleges has been reported to be mainly related to non-academic reasons such as student isolation and an unclear choice of major (2).

In college chemistry, students typically find major difficulties due to the demands of reading comprehension and quantitative skills associated with an abstract discipline. In a study on abstract thinking among college chemistry and physics students, Kolodiy (3) found that from 50 to 75 percent of these students were unable to think at the formal level which is inherent in these subjects. This study involved two and four year colleges and sheds some light on why typical attrition rates in general college chemistry average 50%.

The impact of high attrition rates can be significant. At Burlington County College[1] it has been estimated that a 20% increase in retention translates to approximately $500,000 from student tuition, county and state funding. Even small increases in retention result in long-range positive impacts since successful students are a major component of effective marketing.

Focus of the Study

The major focus of this study was an examination of available academic records of students in General College Chemistry (CHE 105) for Fall 1987 to determine if any variables could be used in academic advisement as a retention strategy. A secondary approach to improving retention was the use of a brief survey sent to all unsuccessful students in CHE 105. Unsuccessful students in this study received grades of D, F or did not complete the course for academic and non-

academic reasons. The survey which follows later in this paper solicited students perception of why they were unsuccessful. Questions relate to course difficulty, employment schedule and what students would do differently prior to enrolling in CHE 105 in terms of academic preperation.

At our college, BCC, students who enroll full-time or have amassed 8 credits are required to take the New Jersey Basic Skills Placement Tests (NJBST) in english, reading, computational skills and elementary algebra. The test results are used to place students in appropriate basic skills courses. In this study (n=126) 60% of the students had taken these tests. While no tests used for academic predictive purposes such as SAT's or ACT's are required or available, individual placement tests are given in individual courses by instructors. Currently students are placed in CHE 105 on the basis of prerequisites.

General College Chemistry at BCC enrolls students majoring in the physical and biological sciences such as engineering, medicine, biology, chemistry, physics, environmental science and allied health sciences. A small percentage (3%) are non-science majors. The course pre-requisites are a prior course in high school or college preparatory chemistry and intermediate algebra. The course structured in topics designated by American Chemical Society guidelines requires skills in reading at the 13-14 level, mathematical calculations, data collection and interpretation along with the ability to conceptualize.

Prior Attempts at Retention

Due to a wide spectrum of academic aptitudes found in open-door colleges, CHE 105 includes techniques designed to minimize the impact of inadequately prepared students. Instructional objectives, frequent testing, some media based activities and elements of programmed instruction have helped to reduce attrition rates from

50% in the early 70's to about 30% in the last decade. Attempts to reduce attrition using educational models is not unique. Many open-door colleges moved towards the approach described by Bloom (4). In such an approach student evaluation is based on criterion referenced measurement - a system where students compete against a stated level of academic proficiency and not other students. Such techniques have been widely used with students of varied verbal and reading skills - two variable highly correlated with academic success at all levels. The course, CHE 105, includes an individualized program of topics such as mathematics and chemical topics which students typically find difficult. Our college offers a well organized preparatory chemistry course for students with weak or no prior background in chemistry.

Academic Records - The Results

The grade distribution for CHE 105 is shown in Table 1. The distributions have remained quite stable over the last decade varying by only a few percentage points. Since a criterion referenced evaluation system is used in this course students in different years with the same grade should be at the same level of academic proficiency. This condition lends itself nicely to statistical analyses over a period of years.

Table 1 - Grade Distributions

GRADE:	A	B	C	D	F	X	W	E	Z	Attrition
%:	21.4	21.4	26.2	2.3	13.5	4.7	6.3	2.3	1.6	30.0

Number of Students = 126

An X grade is given to students who cannot complete the course for non-academic reasons beyond mid-term. Students must repeat the course. A grade of W is given to students who withdraw before mid-term. A grade of E is given for students withdrawing for medical reasons. A grade of Z is given for students who withdraw during the first ten days of the term.

Of all the parameters compared to achievement in CHE 105 only two were significant in ranges normally reported in literature. They were GPA and SR - success ratio which is expressed in this study as the percent of credits successfully completed over credits attempted. The New Jersey Basic Skills scores did not correlate - all were close to 0.00 - with achievement in CHE 105. While these tests are not designed as academic potential predictors but as tests of minimum skills it was hoped that they could be useful since so little student data are available. A possible conclusion that could be reached is that the basic skills experience was successful since students of all beginning skill levels appear to succeed in CHE 105 with no discernible pattern. It is also possible that these tests - the NJBST - are measuring a skill level that is too low to discriminate students.

Table 2 shows the academic profile for students in each grade category including those who were unsuccessful. Evidently CHE 105 students achieve at the same level in chemistry as they do in other disciplines. There is a striking difference in GPA and SR - success ratios - between the successful and unsuccessful students.

Table 2 - Grade Point Average and SR Values for Chemistry Students in Each Grade Category

N	Group Grade	Mean GPA[2]	SR[3]
27	A	3.65	85.3%
27	B	3.08	83.1%
33	C	2.38	73.0%
39	U[1]	1.41	38.5%

1 U - Unsuccessful students with grades lower than C or who withdrew for reasons cited earlier.

2 G.P.A - A=4.0, B=3.0, C=2.0, D=1.0, F=0.0

3 SR - Success ratio in percent. The number of credits completed divided by the number attempted.

evening student and R=0.35 for day students. While math level is correlated to CHE 105 success it is not high enough to use a single predictor.

Table 4 - Prior Mathematics Level and Success in General Chemistry (CHE 105)[a]

Mean Math Level[b]	4.7	4.3	3.3	2.7
Mean CHE 105 Grade	A	B	C	U

[a] Data from student records

[b] 1.0 - Basic Math
2.0 - Elementary Algebra
3.0 - Intermediate Algebra
4.0 - Trigonometry
5.0 - Pre-calculus
6.0 - Calculus I
7.0 - Calculus II
8.0 - Differential Equations

Since CHE 105 is usually taken in freshman year, not all students had prior coursework on which a GPA and success ratio can be computed. Sixty (60) percent of the class had taken prior coursework. A more useful approach to advisement is found in table 5 which shows the probability of success in CHE 105 with each GPA range shown. The values under each grade represent percentage probability. A student with a GPA of 1.90 would have a 78.8% chance of failing or dropping out of CHE 105 and virtually no chance of earning a grade of A or B. This table was constructed using a CHI square statistical technique.

Table 5 - Expectancy Table: GPA Range as a Predictor of Success in General Chemistry as %

Grade:	U	C	B	A
GPA Range				
0.00-1.99	78.8	21.2	0.0	0.0
2.00-2.49	26.3	68.4	5.3	0.0
2.50-2.99	9.5	38.1	38.1	14.3
3.00-4.00	11.3	9.4	34.0	45.3

CHI square = 96.02; significant on the 0.01 level.

Values under each grade are listed as percent.

Introductory Chemistry - CHE 101

This course was developed for students with little or no background in Chemistry as a prerequisite to CHE 105. In a chemistry department study completed in 1987 it was shown that for students who complete CHE 101 with a grade of B or A, eighty-eight (88) percent are successful in college chemistry. In this study only 15 percent of the unsuccessful students and 24 percent of the successful students were enrolled in CHE 101. This course provides background in chemical concepts and much needed experience in a college environment before enrolling in courses at a higher level.

Recommended Advisement Criteria

Based on the data in this study the following criteria for placement in general college chemistry are recommended:

1. a GPA $\geq$ 2.00
2. a success ratio SR $\geq$ 73%
3. a math level ML $\geq$ 3.00 (intermediate algebra)
4. a recent course in CHE 101 or equivalent with a minimum grade of B.

A Post Facto Analysis

The recommended advisement criteria applied to the unsuccessful students in CHE 105 (n=39) resulted in the following:

Table 6 - % Failing To Meet Any One of the Criterion Listed

GPA, SR, ML, CHE 101	GPA, SR, ML	GPA, SR	ML	CHE 101
82%	77%	46%	59%	74%
n=32	n=30	n=18	n=23	n=29

Using the most highly correlated criteria of GPA and SR would have resulted in a decrease in attrition of 46%. For N=39, six (6) students had no prior academic

records, twenty-two (22) had prior GPA's and SR's and eleven (11) had only basic skills scores. Using GPA and SR data to place the successful students in CHE 105 (n=87) would have excluded 1 student in the B grade category and 5 students in the C category.

The Survey

The brief survey which follows was sent to all unsuccessful students. Tinto (8) indicated that surveys of students sho have left the courses are particularly useful since these students feel free to express themselves. For this reason it was decided to use survey results although the return rate was low (31%).

CHE 105 Survey

Please rank the answers to questions 1 and 2 using a scale from 1 to 5, where 5 is the most important and 1 is the least important.

1. What, in your opinion was the most difficult part of the course?
   a. reading the text
   b. taking notes
   c. the mathematics in the course
   d. the chemical concepts
   e. the time pressure to complete assignments and prepare for exams
   f. other - please comment

2. If you could repeat your past experience in CHE 105, what would you have done differently?
   a. taken a math pre-requisite
   b. taken a chemistry pre-requisite
   c. taken a reading pre-requisite
   d. waited a semester or two before taking CHE 105
   e. other

3. How many hours a week were you employed when enrolled in CHE 105?
   a. 0 - 10
   b. 10 - 20
   c. 20 - 30
   d. 30 - 40

Table 7 indicates the students responses to items related to course difficulty and how students might prepare themselves for taking the course again. It is clear that academic courses are not the sole reason why students do not succeed in college. Sine the most critical time related to student dropout is the first six months of college (1, 9), freshmen orientations need to be designed with college survival skills in mind. A highly successful approach to this problem which has attracted national attention is described by Greene (10).

Table 7 - Survey Responses to Questions 1 and 2

Course Difficulty		Repeating CHE 105	
Time Pressure	4.00	Math Pre-requisite	3.40
Note Taking	3.50	Chemistry Pre-requisite	3.30
Chemical Concepts	3.20	Reading Course	2.40
Mathematics	2.30	Delaying Enrollment	2.30
Reading the Text	2.12		

Table 8 indicates the average number of credits taken per semester and the average weekly employment record for students surveyed. The number of credits is approximately 3 four credit courses or 4 three credit courses for a 15 week semester. The driving force behind the need to work an unreasonable number of hours weekly is often unrelated to financial need. Greenberger and Steinberg (9) theorize on the pressures put on students to work by both parents and the business world despite the adverse academic effects which follow.

Table 8 - Course Load - Employment Record

Mean # Credits Fall 87	Mean # hours employed weekly
11.6 credits	24.0 hours

Summary

Predicting academic success for students is complex. No single variable appears to be predictive enough to be used in general college chemistry at Burlington County College. Despite the lack of available predictive scores such as SAT's

it is possible to reduce attrition appreciably using academic parameters such as available GPA's, success ratios and prior math and chemistry backgrounds.

The most highly correlated variables with success in general college chemistry were GPA and the success ratio. They may also be highly reflective of non-academic skills such as maturity and persistance. In this study the GPA was the variable used to predict chemistry grades in an expectancy table (table 5). It is felt that this variable reflects student academic proficiency more than the success ratio. While prior math level did not correlate highly with success in chemistry 91% of the students in the A and B grade category had math levels at or above the course math pre-requisites. Fifty-nine (59) percent of the students who failed or dropped the course had a math level lower than the course pre-requisites.

The impact of a successful prior experience in chemistry such as an introductory level chemistry course is evident. This experience provides more than an introduction to chemical concepts - it provides an orientation to a college environment at a level appropriate to the skills of many students.

In New Jersey, the recent College Outcomes Evaluation Program (COEP) outlines a wide-range agenda for educational assessment in public institutions of higher education and the undergraduate level. A major component of the program lies in the areas of student retention, GPA's and causes of student withdrawal. The advisement model developed in this study lends itself to the COEP agenda (11).

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